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(54) Ink container cartridge and manufacturing method therefor.

(57) An ink container cartridge includes an ink containing portion ; a plug for being pierced by a hollow needle ; a device for preventing reverse flow of the ink to the containing portion, the preventing device comprising a valve, a first liquid passage in which the valve is movable and a second passage disposed closer to the ink containing portion than the first passage, and the valve is capable of closing the second passage.

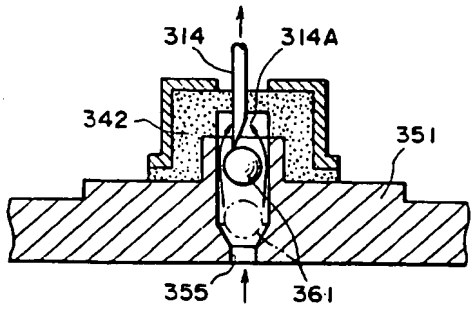

FIG. 5A

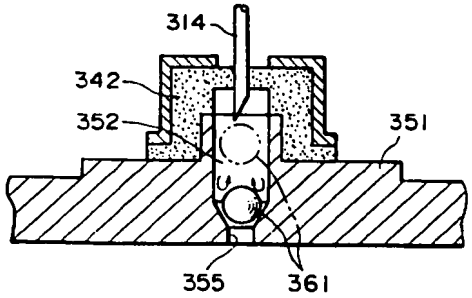

FIG. 5B

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communicating with the ink containing portion and a plug for plugging the liquid passage; filling the containing portion with ink; mounting a valve into the liquid passage; mounting the plug; effecting sucking through the plug to discharge air from said containing portion.

According to a further aspect of the present invention, said valve is set between the projections before said plugging step, and the valve is urged inwardly beyond the first projection.

According to a yet further aspect of the present invention, there is provided an ink jet recording apparatus, comprising: an ink container cartridge including an ink containing portion; a plug for being pierced by a hollow needle; means for preventing reverse flow of the ink to said containing portion, said preventing means comprising a valve, a first liquid passage in which said valve is movable and a second passage disposed closer to said ink containing portion than said first passage, and said valve is capable of closing the second passage; a recording head having a portion detachably mounting said ink container cartridge; means for receiving the recording head; and recovery means for recovering operation of said recording head.

The recovery means may introduced the air through the ink ejection outlets of the recording head prior to the recovering operation.

According to the present invention, the reverse flow of the ink to the ink container is effectively prevented, and therefore, the introduction of the air into the ink supply system can be prevented when the recording head is dismounted or in the recovery operation in which the air is introduced through the ejection outlets. Therefore, the quantity of the ink consumed for the ejection recovery operation for refilling the ink in the ink supply system or the recording head, can be reduced.

These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of an ink jet recording apparatus to which the present invention is applicable.

Figure 2 illustrates a recording head and a cap therefor in the apparatus of Figure 1.

Figure 3 is a perspective view of an ink cartridge mounting portion in the apparatus of Figure 1.

Figure 4 is a sectional view of an ink communicating part of an ink cartridge according to a first embodiment of the present invention.

Figures 5A and 5B are sectional views illustrating operation of the ink cartridge of the first embodiment.

Figure 6 illustrates operation of the air introduction prior to the recovery operation of the ink supply system in the ink cartridge of the first embodiment.

Figure 7 is a sectional view illustrating the recovery operation for the ink supply system in the apparatus of the first embodiment.

Figure 8 is a sectional view illustrating the operation when the recording head is dismounted in a conventional apparatus.

Figure 9 is a sectional view illustrating operation of the air introduction in the conventional ink supply system.

Figure 10 illustrates manufacturing of the ink cartridge in accordance with a first embodiment of the present invention.

Figure 11 is a sectional view of an ink communicating position of an ink cartridge according to a second embodiment of the present invention.

Figure 12 is a sectional view illustrating the configuration of a projection in the cartridge of Figure 11.

Figure 13 illustrates the manufacturing step of the ink cartridge according to a second embodiment of the present invention.

Figure 14 is a sectional view of an ink communicating portion of an ink cartridge according to a third embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figure 1, there is shown an ink jet recording apparatus according to an embodiment of the present invention. In this Figure, a cover has been removed. Figure 2 shows a recording head and a cap member of this apparatus.

The recording head 1 is in the form of a chip and is mountable onto a carriage 2 which is reciprocable. The carriage 2 is provided with a supporting member for detachably mounting the recording head 1 thereon and a covering member (chain lines) for protecting a substrate which constitutes a part of the recording head 1 and which has driving circuit or the like printed thereon.

As shown in Figure 2, the recording head 1 is provided with 64 ejection outlets 101 at its front side, although only three ejection outlets are shown in Figure 2. Each of the ejection outlets 101 is connected with an ink passage 103 communicating therewith. Behind the ink passage 103, there is a common ink chamber 105 for supplying the ink to the liquid passages 103. Each of the ink passages is provided with an electrothermal transducer element 107 for generating thermal energy to create film boiling to eject droplets of the ink through the ejection outlet and is also provided with electrode wiring for supplying electric power to the electrothermal transducer element 107. To the common chamber 103, the ink is supplied through a supply tube 109.

from the recording head and to carry out the sucking operation with the pump 24. More particularly, the rotational driving force of the feed motor mounted on a part of the main assembly frame is transmitted to a transmission gear train 19. The gear grain 19 is effective to select proper gears for movement of the carriage 2, the scanning movement of the recording head 1, movement of the recording head 1 to the home position or to the ejection recovery position and for stoppage at this position, by the selection gears (not shown) in response to these operations. The rotation of the gears in the gear train 19 is transmitted through an intermediate gear 20 to the sheet feeding roller 5 and the sheet discharging roller 4, and to an integral cap 13 or the like through a cam 16, and is to the pump 24 through a pump gear 22 and a pump cam 23.

As regards the ink supply to the recording head 1, a hollow needle 314 pierces a plug of an ink cartridge 27 mounted on the main assembly of the recording apparatus, and a flexible tube capable of following movement of the carriage 2 is used. As will be understood from Figure 1 and other drawings, the cartridge 27 is at a vertical level lower than the ejection outlets of the recording head. The position of the carriage 2 is detected by counting number of steps of the carriage motor on the basis of a reference position where the home position sensor 11 of the carriage 2 corresponds to a home position detecting flag disposed adjacent an end of the moving region of the carriage 2.

Figure 3 illustrates the interconnection between the ink cartridge 27 and the main assembly. Designated by reference numerals 271 and 340 are cartridge casing and an ink bladder for accommodating the ink to be supplied, which is accommodated in turn in the casing 271. The bladder has a rubber plug 342. The needle 314 is inserted into the plug 342, and further insertion permits communication with the ink. An absorbing material 344 functions to accommodate residual ink discharged by the operation of the ejection recovery mechanism through a residual ink pipe 318 and is connected with an ink absorbing material disposed below the ink bladder.

A wiring pattern 346 is provided on the top surface of the ink cartridge 27, and the controller of the main assembly is able to detect presence or absence of the ink cartridge in accordance with connection or disconnection between contact 306A and 306B through the pattern 346. The pattern may be changed in accordance with the color or density of the ink in the resistance of the wiring pattern, and then, the controller of the main assembly is able to aware of the information.

A click 320 functions as a fastener for the ink cartridge 27, and is provided one at each side of the cartridge receptor. The click 320 flexes by its elasticity upon engagement with a side surface of the cartridge 27 when it is inserted or removed, so that the insertion or removal action of the cartridge 27 is permitted, while holding the cartridge 27 at a proper position by restoring its original configuration when it is received by a recess 332 of the cartridge 27.

Figure 4 shows an example of the ink communicating portion of the ink cartridge. Designated by a reference 351 is a passage forming member in the ink bladder 340, which is effective to provide the liquid passage 352. The passage 352 is in a circular form having a diameter D3 at a portion 353, and a diameter D2 which is smaller than the diameter D3 in the portion 355. The large diameter and small diameter portions are connected by a portion 357. A ball 361 functions as a valve and is made of polytetrafluoroethylene resin and has a diameter D1 which is smaller than the diameter D3 of the passage portion 353 and which is larger than the diameter D2 of the passage portion 355. The plug 342 made of rubber or the like covers a projection 351A from the passage forming member 351 from which the passage portion 353 is formed, and is held on the ink bladder 340 by a confining member 344.

During the ink supply in the normal recording and in the ejection recovery operation, as shown in Figure 5A, the ball 361 moves from the position indicated by the chain linein the feeding direction by the force resulting from the ink supply from the ink bladder, for example, the flow of the ink. It abuts a tip end of the needle 314, as indicated by the solid lines, and therefore, the tip end is tapered as indicated by a reference 314A, the flow of the ink is not obstructed, and is supplied to the ink supply system as indicated by an arrow.

When, on the other hand, the recording head 1 is removed from the main assembly or when the air is charged with the aid of the cap 13, the ink once flows back to the bladder, but as shown in Figure 5B, the ball 361 moves in the opposite direction by the force resulting from the reverse flow from the position indicated by the chain line, until it closes the passage portion 355 as shown by the solid line. It is retained thereby the force from the ink, so that the backward flow of the ink toward the ink bladder 341 is stopped.

The position of the tip end 314A of the needle 314 is so determined that it pushes the ball 361 but does not close the passage. This is accomplished by determining the dimension of the needle and the mounting position thereof or the like so that the positional relations as shown in Figure 5 is established at the click position.

The advantageous effects of the present invention will be described with respect to the ejection recovery operation.

Referring to Figures 6 and 7, there is illustrated an ink supply system in the air charging and sucking operation for the purpose of ejection recovery. An ink absorbing material 281 is disposed at the bottom of the cartridge 27. A subordinate container 121 is provided to trap the air in the ink supply system and to

jection 379B toward the ink bladder side.

In this embodiment, the improper air introduction by the reverse flow of the ink can be similarly prevented, and therefore proper ink supply can be maintained. Similarly to the foregoing embodiment, the tip end position of the needle 314 is so determined that it does not urge the ball 361 to the passage portion 375. The end position is, however, is above the projection 379B so as to prevent the contact between the ball 361 and the tip end, and therefore, the damage of the ball 361 or the needle 314 by the contact can be avoided. The distance t between the inside bottom of the plug 342 and the top surface of the projection 371A of the passage forming member 371 covered by the plug 342 is not particularly considered, because the ball 361 does not fall in this embodiment.

Figure 13 illustrates the manufacturing step , of the cartridge 27. At step STP11, the ball 361 is pressed to between the upper and lower projections 379A and 379B of the passage forming member 371 of the ink bladder 340. At step STP13, the rubber plug 342 is set. Thereafter, the ink bladder 340 is accommodated in the cartridge casing, and the cover is mounted, thus completing the assembling of the cartridge 27 (step 15).

Then, at step STP17, the proper hollow needle N is pierced into the plug 342 to supply the ink and discharge the air. At this time, the flow of the ink and the air are through the clearance between the segments of projections 379A and 379B. After the filling operation is completed, a proper pushing rod B (the needle N may be usable for this purpose) is used to push the ball 361 to below the projection 379B, at step 19. Then, the package is processed to the next inspection and package steps. The upper projections 379A is not always necessary from the standpoint of the function of the ink cartridge. However, in order to prevent falling of the ball 361 between the step STP11 and the step STP13, and in order to prevent vibration or movement of the ball 361 when the ink is injected at step STP11, thus avoiding damage by the contact between the needle N and the ball 361, it is preferable to provide the upper projections 379A.

The ink cartridge may be put on sale with the ball 361 placed between the projections 379A and 379B. In this case, by mounting the cartridge in the apparatus, the ink supply needle urges the ball 361.

Figure 14 illustrates an ink cartridge according to a third embodiment which is a modification of the first embodiment. This embodiment is similar to Figure 4 embodiment with the exception that the passage forming member 381 having a passage portion 385 with an inside diameter which is smaller than the ball 361 is mounted to the outlet side of the passage forming member 351. During the normal ink supply, the end of the needle 341 is placed outside the passage portion 185, so that the ink supply is not obstructed.

The ink reverse preventing effect is the same as in the foregoing embodiments. In this embodiment, the ink leakage from the ink cartridge 27 after it is removed after use-up of the cartridge can be accomplished. If the plug 142 is deteriorated in its material with time, the pierce by the needle 114 is not completely closed when the cartridge is removed from the main assembly of the recording apparatus. If this is the case, the remaining ink may leak out. According to this embodiment, however, the leaking motion of the ink is effective to displace the ball 161 toward the outlet so as to close the passage 195. Therefore, the leakage of the ink can be prevented.

The passage of this embodiment can be formed through the similar steps as in Figure 10 but with an additional step between the step STP1 and the step STP5 a step of mounting the member 181 by bonding or the like. In this embodiment, the clearance t is not particularly considered. This is similar to the case of the second embodiment.

The present invention is particularly suitably usable in an ink jet recording head and recording apparatus wherein thermal energy by an electrothermal transducer, laser beam or the like is used to cause a change of state of the ink to eject or discharge the ink. This is because the high density of the picture elements and the high resolution of the recording are possible.

The typical structure and the operational principle are preferably the ones disclosed in U.S. Patent Nos. 4,721,129 and 4,740,796. The principle and structure are applicable to a so-called on-demand type recording system and a continuous type recording system. Particularly, however, it is suitable for the on-demand type because the principle is such that at least one driving signal is applied to an electrothermal transducer disposed on a liquid (ink) retaining sheet or liquid passage, the driving signal being enough to provide such a quick temperature rise beyond a departure from nucleation boiling point, by which the thermal energy is provided by the electrothermal transducer to produce film boiling on the heating portion of the recording head, whereby a bubble can be formed in the liquid (ink) corresponding to each of the driving signals. By the production, development and contraction of the the bubble, the liquid (ink) is ejected through an ejection outlet to produce at least one droplet. The driving signal preferably in the form of a pulse, because the development and contraction of the bubble can be effected instantaneously, and therefore, the liquid (ink) is ejected with quick response. The driving signal in the form of the pulse is preferably such as disclosed in U.S. Patents Nos. 4,463,359 and 4,345,262. In addition, the temperature increasing rate of the heating surface is preferably such as disclosed in U.S. Patent No. 4,313,124.

The structure of the recording head may be as shown in U.S. Patent Nos. 4,558,333 and 4,459,600 wherein the heating portion is disposed at a bent por-

capable of closing the second passage.

2. A cartridge according to Claim 1, wherein the first passage has a length larger than an insertion length of the needle to avoid influence to movement of the valve.

3. A cartridge according to Claim 1, wherein a diameter of the second passage is smaller than that of the first passage.

4. A cartridge according to Claim 1, wherein said first passage is provided with an inward projection.

5. A cartridge according to Claim 1, wherein the first passage is provided with smaller diameter portion at a side away from said ink containing portion.

6. A method of manufacturing an ink cartridge, comprising:

preparing an ink container having an ink containing portion, a liquid passage communicating with the ink containing portion and a plug for plugging the liquid passage;

filling the containing portion with ink;

mounting a valve into the liquid passage;

mounting the plug;

effecting sucking through the plug to discharge air from said containing portion.

7. A method according to Claim 6, wherein said passage is provided with a projection for preventing movement of the valve away from the containing portion but permits passage of the ink.

8. A method according to Claim 6, wherein said passage further comprises a second projection, and said valve is accommodated between the first and second projections.

9. A method according to Claim 8, wherein said valve is set between the projections before said plugging step, and the valve is urged inwardly beyond the first projection.

10. A cartridge according to Claim 2, further comprising a third passage extending from said second passage which can be closed by said valve.

11. An ink jet recording apparatus, comprising:

an ink container cartridge including an ink containing portion; a plug for being pierced by a hollow needle;

means for preventing reverse flow of the ink to said containing portion, said preventing means comprising a valve, a first liquid passage in which said valve is movable and a second passage disposed closer to said ink containing portion than said first passage, and said valve is capable of closing the second passage;

a recording head having a portion detachably mounting said ink container cartridge;

means for receiving the recording head; and

recovery means for recovering operation of said recording head.

12. An ink jet recording apparatus according to Claim 11, wherein said recovery means charges air into said recording head.

13. An apparatus according to Claim 11, wherein said recording head including means for producing thermal energy for producing film boiling to eject the ink.

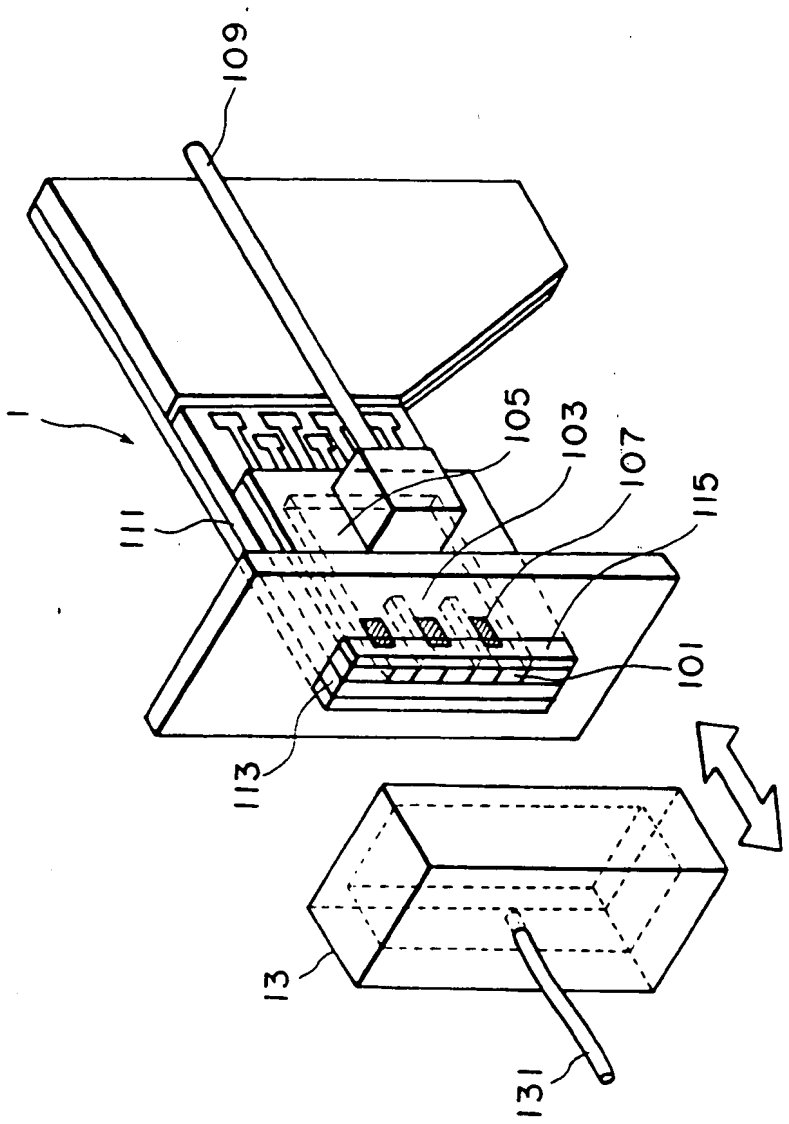

FIG. 2

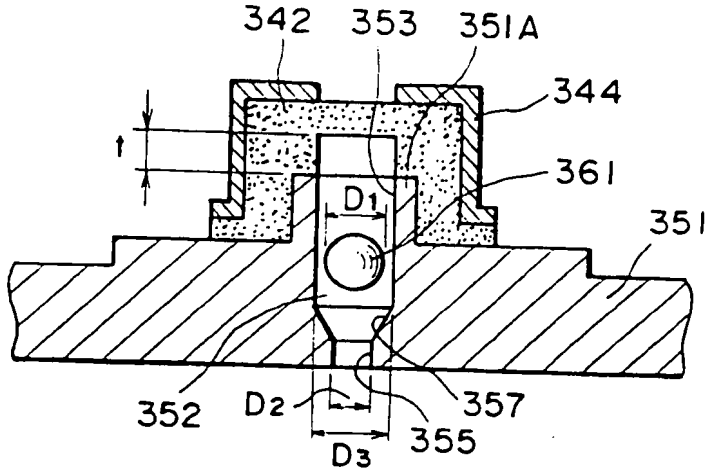

FIG. 4

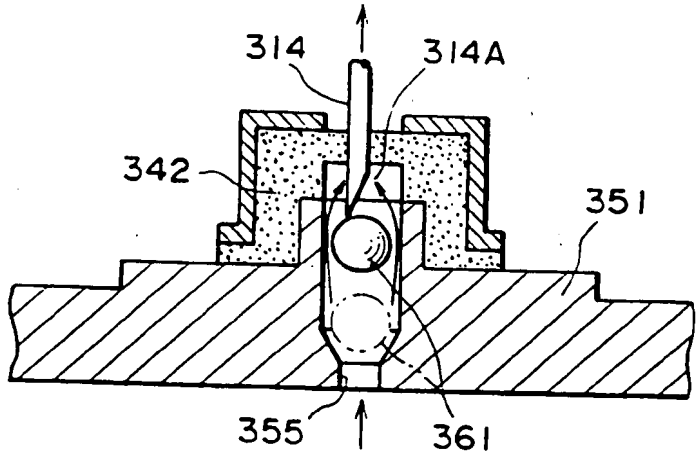

FIG. 5A

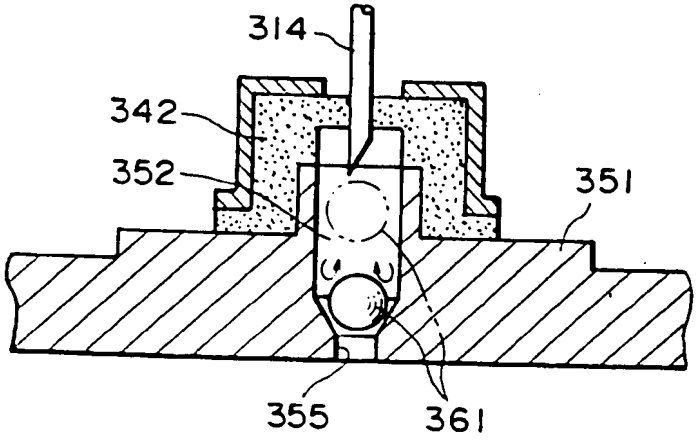

FIG. 5B

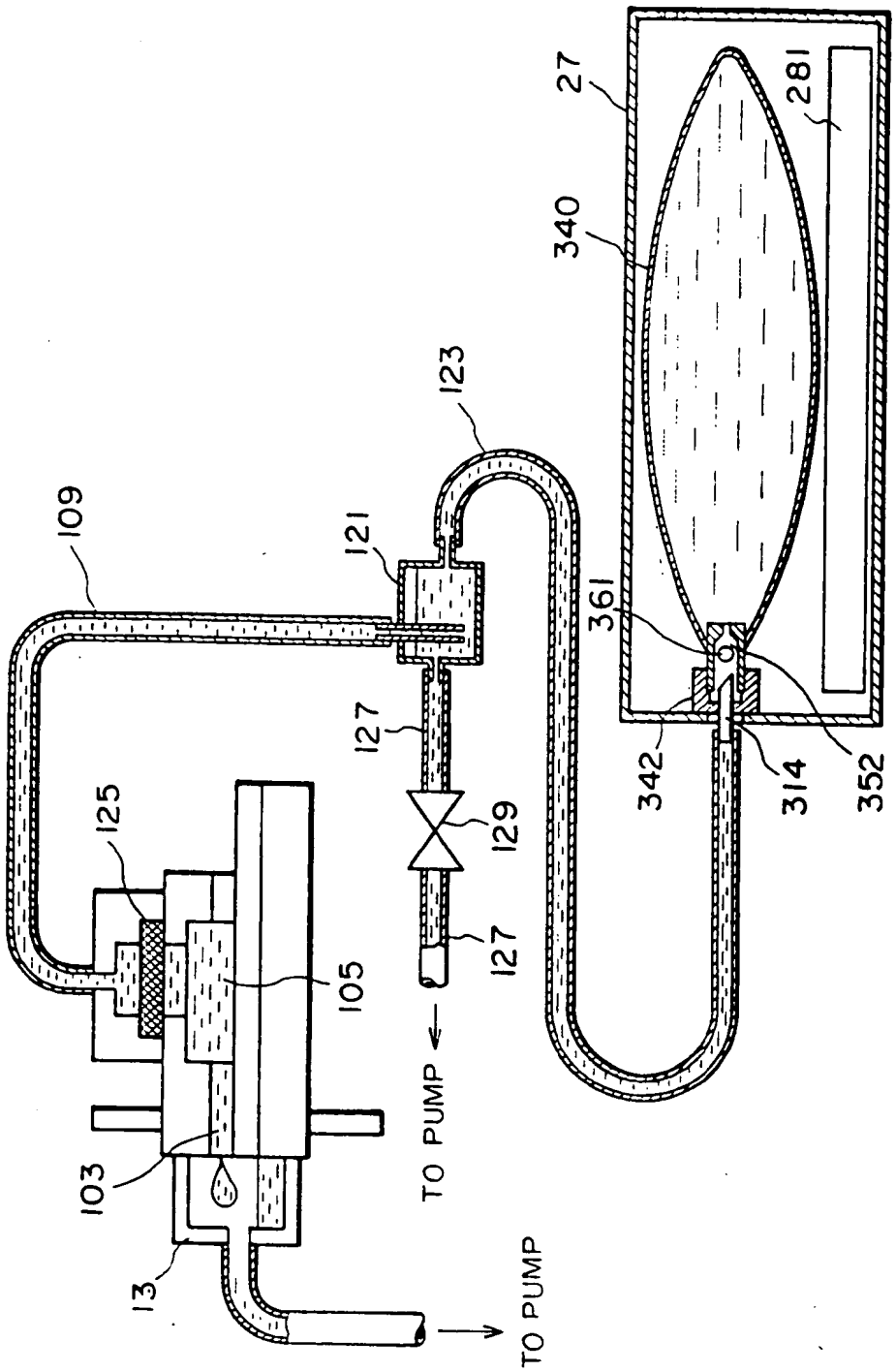

FIG. 7

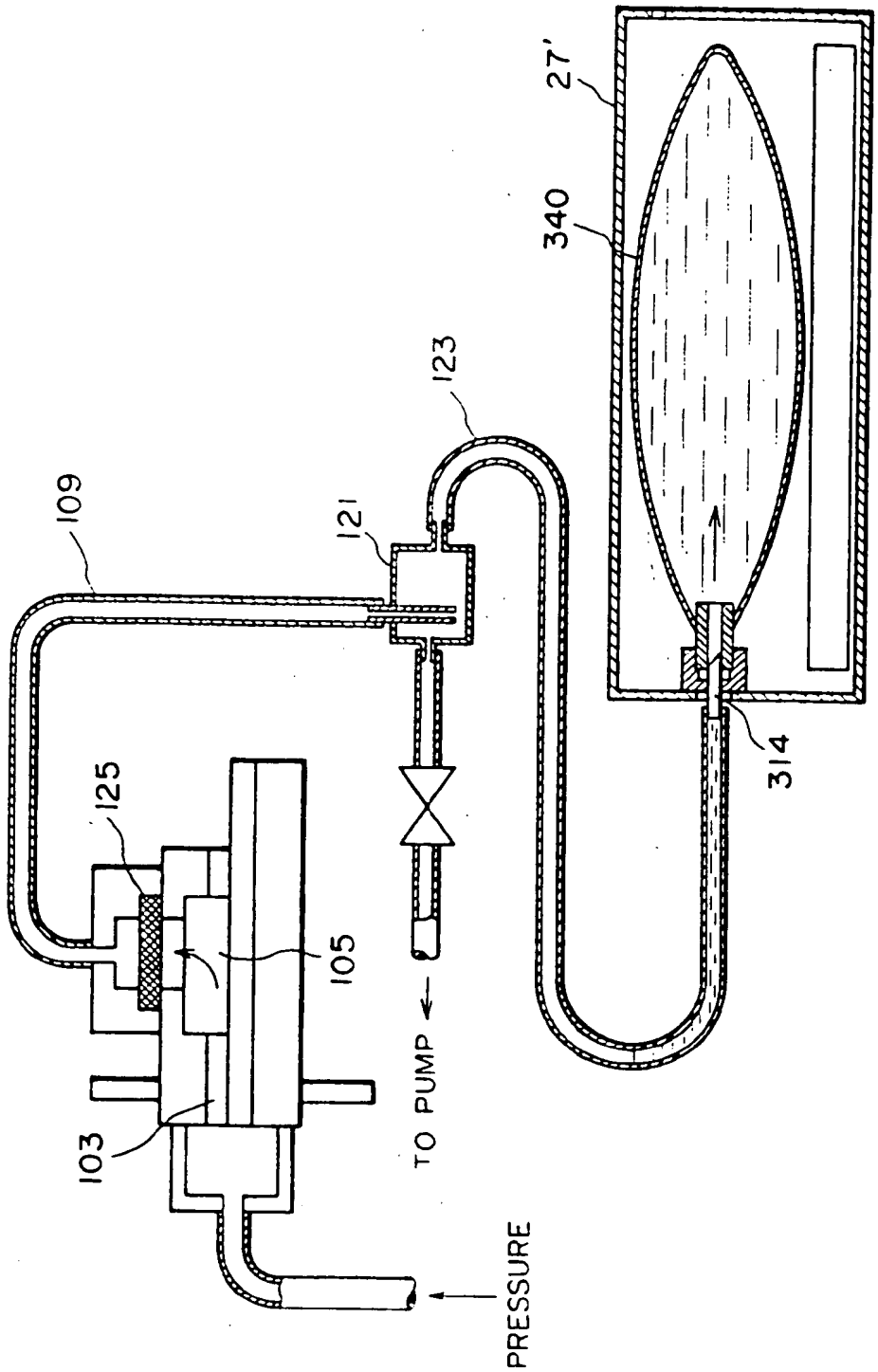

FIG. 9

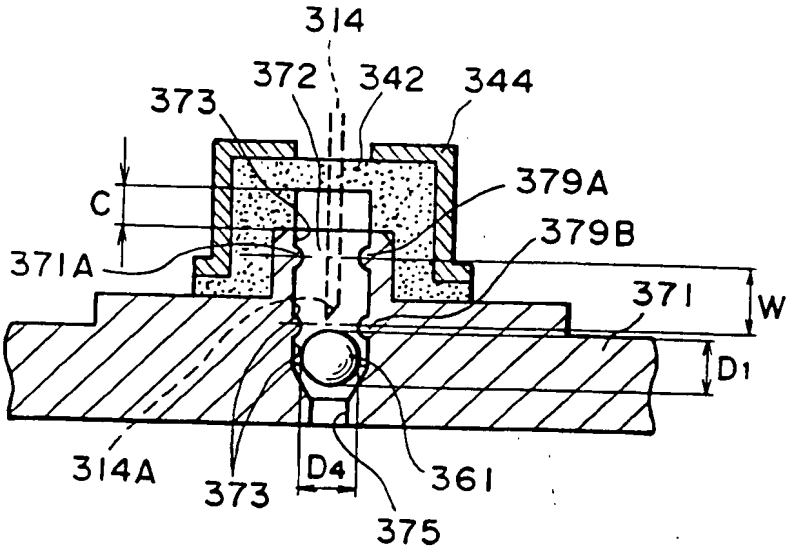

FIG. 11

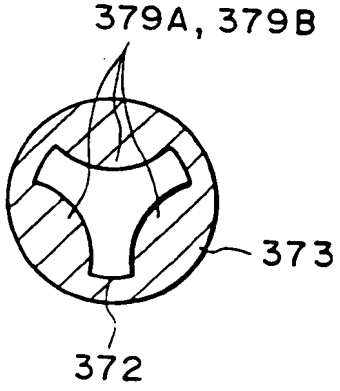

FIG. 12

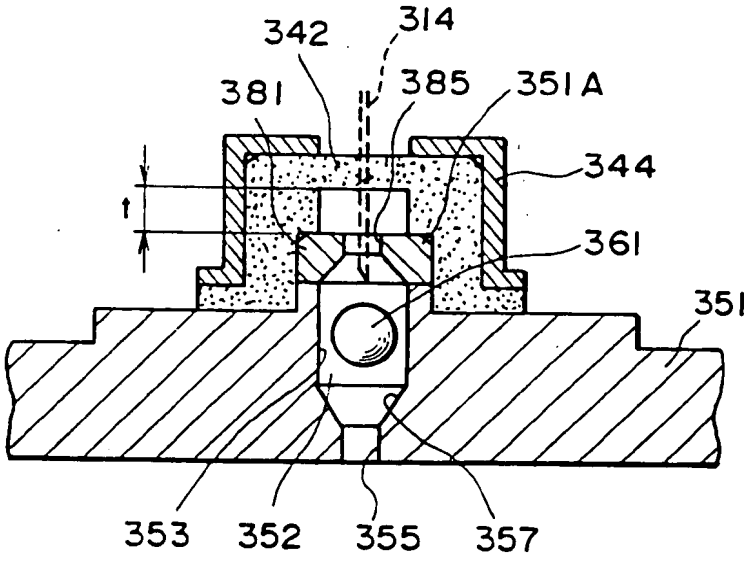

FIG. 14